Global Hydrology Resource Center

Data User Guide

GPM Ground Validation NOAA CPC Morphing Technique (CMORPH) IPHEx

Introduction

The GPM Ground Validation NOAA CPC Morphing Technique (CMORPH) IPHEx dataset consists of global precipitation analyses data produced by the NOAA Climate Prediction Center (CPC) during the Global Precipitation Mission (GPM) Integrated Precipitation and Hydrology Experiment (IPHEx) field campaign in North Carolina. The goal of IPHEx was to evaluate the accuracy of satellite precipitation measurements and use the collected data for hydrology models in the region. The CPC morphing technique uses precipitation estimates from low orbiter satellite microwave observations to produce global precipitation analyses at a high temporal and spatial resolution. CMORPH data has been selected from May 1, 2014 through June 14, 2014, during the IPHEx field campaign. These data files are available in raw binary and netCDF-4 file format.

Citation

Joyce, Robert. 2016. GPM Ground Validation NOAA CPC Morphing Technique (CMORPH) IPHEx [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. DOI: http://dx.doi.org/10.5067/GPMGV/IPHEX/CMORPH/DATA201

Keywords:

NASA, NOAA, GHRC, GPM GV, PMM, IPHEx, North Carolina, global, CMORPH, rainfall rate

Campaign

The Global Precipitation Measurement mission Ground Validation (GPM GV) campaign used a variety of methods for validation of GPM satellite constellation measurements prior to and after launch on the GPM Core Satellite, which launched on February 27, 2014. The instrument validation effort included numerous GPM-specific and joint-agency/international external field campaigns, using state of the art cloud and

precipitation observational infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). These field campaigns accounted for the majority of the effort and resources expended by the GPM GV mission. More information about the GPM GV mission is available at the PMM Ground Validation webpage.

One of the GPM GV field campaigns was the Integrated Precipitation and Hydrology Experiment (IPHEx), which was held in North Carolina during 2014 with an intense study period from May 1 to June 15, 2014. The goal of IPHEx was to characterize warm season orographic precipitation regimes and the relationship between precipitation regimes and hydrologic processes in regions of complex terrain. The IPHEx campaign was a part of the development, evaluation, and improvement of remote sensing precipitation algorithms in support of the GPM mission through the NASA GPM GV field campaign (IPHEX_GVFC) and the evaluation of Quantitative Precipitation Estimation (QPE) products for hydrological forecasting and water resource applications in the Upper Tennessee, Catawba-Santee, Yadkin-Pee Dee, and Savannah river basins (IPHEX-HAP, H4SE). NOAA Hydrometeorology Testbed (HTM) has synergy with this project. More information about IPHEx is available at the IPHEx Field Campaign webpage.

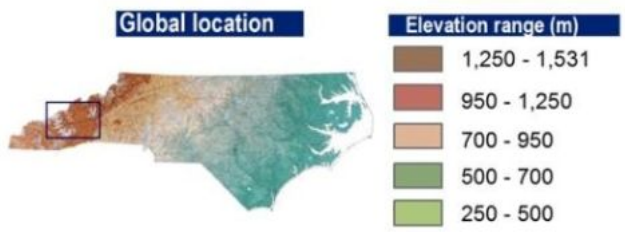

Figure 1: Region of North Carolina IPHEx campaign ground validation
(Image source: http://gpm-gv.gsfc.nasa.gov/Gauge/)

Product Description

The CPC Morphing Technique, or CMORPH, is a technique that uses precipitation estimates from low orbiter satellite microwave observations to produce global precipitation analyses at high temporal and spatial resolution. Table 1 shows a list of the passive microwave instruments whose measurements were used to derive the precipitation estimates.

Table 1: Passive microwave instruments used to derive the precipitation estimates

Instrument	Platform
SSM/I	DMSP 13 DMSP 14 DMSP 15
AMSU-B	NOAA-15 NOAA-16 NOAA-17

	NOAA-18
AMSR-E	AQUA
TMI	TRMM

The CMORPH raw data is generated in near real-time and is available at several different spatial and temporal resolutions. This CMORPH dataset, selected for the IPHEx campaign, includes the 30-minute estimates at approximately 0.0727 latitude/longitude spatial resolution (or 8 kilometers at the equator). The data provides global coverage (60 degrees South – 60 degrees North). More information about the CMORPH data product is available in Joyce et al., 2004.

Investigators

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Data Characteristics

The GPM Ground Validation NOAA CPC Morphing Technique (CMORPH) IPHEx data files are available in netCDF-4 and binary formats. These data are Level 4 processing level. More information about the NASA data processing levels is available on the EOSDIS Data Processing Levels webpage.

Table 2: Data Characteristics

Characteristic	Description
Platform	DMSP 13, DMSP 14, DMSP 15, NOAA-15, NOAA-16, NOAA-17, NOAA-18, AQUA, TRMM
Instrument	SSM/I (DMSP 13, DMSP 14, DMSP 15) AMSU-B (NOAA-15, NOAA-16, NOAA-17, NOAA-18) AMSR-E (AQUA) TMI (TRMM)
Spatial Coverage	N: 60.0 , S: -60.0, E: 180.0, W: -180.0 (Global)
Spatial Resolution	0.0727 degrees
Temporal Coverage	May 1, 2014 - June 14, 2014
Temporal Resolution	30 minutes
Sampling Frequency	30 minutes
Parameter	Rainfall rate
Version	1
Processing Level	4

File Naming Convention

The GPM Ground Validation NOAA CPC Morphing Technique (CMORPH) IPHEx data are named with the following convention:

netCDF-4 data files: iphex_CMORPH_YYYYMMDDhhmm.nc
Raw data files: advt-8km-interp-prim-sat-spat-2lag-2.5+5dovlp8kmIR-YYYYMMDDhhmm.Z

Table 3: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
hh	Two-digit hour in UTC
mm	Two-digit minute in UTC
.nc	netCDF-4 format
.Z	Zipped binary file format

Data Format and Parameters

The GPM Ground Validation NOAA CPC Morphing Technique (CMORPH) IPHEx dataset consists of netCDF-4 and binary data files containing rainfall rate estimates. Table 4 lists and describes the parameters in the netCDF-4 data files. These data were derived using the CMORPH technique. More information about CMORPH is available in Joyce et al. (2004).

Table 4: Data Fields within netCDF-4 data files

Field Name	Description	Data Type	Unit
latitude	Latitude of the observation	float	Degrees North
longitude	Longitude of the observation	float	Degrees East
RainRate	Rainfall rate	float	mm/hr
Satellite	The satellite from which the last microwave observation was made, as follows: 13 - DMSP-F13 (SSM/I) 14 - DMSP-F14 (SSM/I) 15 - DMSP-F15 (SSM/I) 16 - DMSP-F16 (SSMIS) 17 - DMSP-F17 (SSMIS) 18 - DMSP-F18 (SSMIS) 115 - NOAA-15 (AMSU-B) 116 - NOAA-16 (AMSU-B) 117 - NOAA-17 (AMSU-B) 118 - NOAA-18 (MHS)	short	-

	119 - NOAA-19 (MHS) 151 - METOP-A (MHS) 201 - TRMM (TMI) 211 - AQUA (AMSR-E) 255 - None		
time	Time of measurement	int	Minutes since time in file name
Time_since_overpass	Time since overpass	short	Minutes

Algorithm

Rainfall rate estimates were generated by the Ferraro (1997) algorithm for SSM/I, the Ferraro et al. (2000) algorithm for AMSU-B, and the Kummerow et al. (2001) algorithm for TMI. This technique allows for rainfall estimates from low orbiter microwave satellite observations to be combined together; despite the different algorithms used to derive those estimates. More information about CMORPH and its methodology can be found at the NWS Climate Precipitation Center webpage and in Joyce et al. (2004).

Quality Assessment

The CMORPH estimates were validated using high-quality rain gauge and radar data. The rain gauge data were used to perform a mean-bias adjustment on the radar estimates. Once these data had been validated, they were then gridded. More information about these validation processes is available in Joyce et al. (2004) and Higgins et al. (2000).

Software

These data are available in netCDF-4 and binary formats. No software is required to view the netCDF-4 data files, but Panoply can be used to easily read and plot the data. A program written by NOAA for the CMORPH half-hourly, 8km data can be used to read the binary files.

Known Issues or Missing Data

In the netCDF-4 files, all missing data field values for rainfall rate are set to -99999.0 and the _FillValue field is set to 0 to enable transparency when visualized.

References

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Kummerow, C., Hong, Y., Olson, W. S., Yang, S., Adler, R. F., McCollum, J., . . . Wilheit, T. T. (2001). The Evolution of the Goddard Profiling Algorithm (GPROF) for Rainfall Estimation from Passive Microwave Sensors. *Journal of Applied Meteorology*, *40*, 1801–1820. https://doi.org/10.1175/1520-0450(2001)040<1801:TEOTGP>2.0.CO;2

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Related Data

All data from other instruments collected during the IPHEx file campaign are related to this dataset. Other IPHEx campaign data can be located by searching 'IPHEX' in the GHRC HyDRO 2.0 search tool.

Below is a dataset from another GPM GV field campaign that used NOAA CMORPH:

GPM GROUND VALIDATION NOAA CPC MORPHING TECHNIQUE (CMORPH) IFLOODS (http://dx.doi.org/10.5067/GPMGV/IFLOODS/CMORPH/DATA201)

Contact Information

To order these data or for further information, please contact:

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